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Report on the Forest of the Kurram valley (Afganistan)

By. C. Bagshawe 1879

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From C. BAGSHAWE, Esq., Deputy Conservator of Forests, on special duty, Kuram Field Force, to the Brigade-Major, 4th Infantry Brigade, Kuram Field Force,—(No. 12, dated Camp Peiwar Kotal, Kuram Valley, the 14th November 1879.)

IN accordance with the orders quoted on the margin, I have the honor to forward, for the information of Brigadier-General Watson, Commanding the Kuram Field Force, the accompanying report on the Forest of the Kuram Assigned District.

Deputy Assistant Quartermaster-General's No. 1070-K. F. F., dated 12th September 1879.
Deputy Assistant Quartermaster-General's No. 2105-K. F. F., dated 17th September 1879.

2. Paras. 1-5 of the report give a brief description of the forest. Para. 6 describes the immediate demands to be made on the forests—

(*a.*)—Villagers' rights to timber, fuel, grazing, &c.,

(*b.*)—The requirements of the Military Department for timber and fuel,

and makes what I trust will be deemed satisfactory proposals for meeting them. Para. 7 goes into the question of the export of the timber from the Kuram to other districts, and will I believe shew the impossibility of at present working these forests on a large scale. Para. 8 makes proposals for the employment of a small and inexpensive forest staff, chiefly for protection purposes. Para. 9 reports on the possibility of using mechanical sawing power in the deodar forest.

3. In conclusion, I have the honor to solicit the favor of your procuring me early orders as to my future movements. In the Kuram district the forests have been examined as far as is now possible; the timber, hutting, and miscellaneous work at the Peiwar Kotal will be completed by about 25th instant; the only work left is to examine the Indus palm (*Chamaerops Ritchieana*) between Kuram and Thul; this if the road and vicinity are safe, I might do between the 26th November and 2nd December, and be ready on that day to start on my return to my duties in the North-Western Provinces.

Memorandum on the Forests of the Kuram Assigned District.

Division of forest area.

1. For purposes of description, the forests of the Kuram District may be divided as follows:—

(*a*).—The Hazár-Darakht forests, extending from Ali Kheyl to the Sirkai Kotal, and lying on both right and left banks of the Hazár-Darakht river.

(*b*).—The Hariáb forests, to the north of the river of that name, and between Mounts Matunga and Sika Rám.

(*c*).—The Peiwar and Mangiár forests, lying on the east and north-west slopes of the range running from Sika Rám, on which Peiwar and Mangiár are well known points.

(*d*).—The Kuram forests lying on the southern slopes of the main range between Sika Rám and Karama peaks.

Hazár-Darakht Forests.

2. The Hazár-Darakht forests are nearly pure deodar. A few juniper (*J. excelsa*) and spruce (*A. Smithiana*) are found in the valleys, and some silver fir (*A. Webbiana*) high up on the ridges and in gorges with a northerly aspect, but deodar forms 90 per cent. of the entire crop.

The forest near the Sirkai Kotal and for several miles down stream have been heavily worked for the supply of the Amir of Afghanistan's works at Kabul, whither the wood was apparently conveyed on camels by forced labour.

No export appears to have taken place from the Hazár-Darakht forests to the plains of India, and the shallow rocky nature of the river seems to forbid floating even during the flood season of March and April. These forests have suffered little from the actions of the villagers. Above and below Rokia cultivation has driven the forest back from the level ground, the trees have been lopped for fuel, and light fellings of poles been made for household purposes. In the Hazár-Darakht forests, as in the Kuram District forests generally, the absence of all under-growth either of shrubs or grass is very marked; fires are consequently of rare occurrence, and are the cause of little damage to the trees: the poorness of the grazing, however, leads to the destruction of much young growth of deodar by sheep and goats.

Owing to grazing, &c., the reproduction in open parts of these forests appears to be in an unsatisfactory state, but information on the point is scanty owing to many parts having been unexplored.

Hariáb Forests.

3. The Hariáb forests consist of deodar, Gerard's pine (*P. Gerardiana*) and blue pine (*P. excelsa*) with a few spruce and silver fir, juniper forming a kind of scrubby bush. Deodar appears to form 70 per cent. of the entire crop, and for some miles to the north-east of Matunga, and from that hill towards Ali Khel the forest is fairly compact and the cover complete, an exception to the rule being some large grassy plateaux in the centre of the forest to the west of Belut.

Should the Kuram river prove one fit for floating sawn timber, these forests may in the remote future yield timber for export to other districts, but their distance from that stream giving a mean land carriage of about ten miles must always prove a great drawback in their value.

The villagers' demand for timber is not large, as they use flat mud roofs, and only want posts, rafters, doors, &c.

In the vicinity of openings in the forest, where grass is found in small quantities, the trees suffer a little from fire, but, as in other parts, grazing is the greatest enemy the trees have, and in the Hariáb the exclusion of grazing is the first preliminary to working the forests.

The villagers have a lazy way of collecting fuel, *viz.*, by lopping branches, and the outer fringe of forest looks very ragged in consequence. It is remarkable what a short distance the villagers go for fuel, and the small quantity that satisfies them; this may however be accounted for by the fact of the upper portion of the Hariáb being abandoned during the winter, owing to the intense cold and a short food supply, which, I understand, make the inhabitants migrate annually to more genial climes. I have been unable to find out much about the seed of Gerard's pine, at what period it seeds, or what the people do with the crop. It certainly is not in seed generally this year, and none of last year's seed is brought for sale, so I presume that was a non-seed year too. In seed years it must be produced in large quantities, and might be made a source of forest revenue by direct collection or the imposition of a tax.

Peiwar and Mangiár Forests.

4. The Peiwar and Mangiár forests form, in my opinion, the most important of the three deodar forests of the Kuram; the block is large, compact, and separated from our own villages. The demands for grazing, fuel, and timber, are chiefly made by non-inhabitants, who, the Political Officer tells me, have probably no rights therein. As soon, therefore, as these adjacent tribes are disarmed, and taught to respect English rule, the introduction of forest management by the Forest Department may, should financial considerations permit it, be feasible.

The Peiwar and Mangiár forests may be described as lying on the eastern and western slopes of the Peiwar range, and extend from the Spingawai Pass (or Kotal) to the Mangiár peak; beyond this peak is Mangal territory, and the forests are unexplored.

Along the ridge we find nearly pure deodar, until you approach the Mangiár peak, where you get into fir and yellow oak (*Q. semicarpefolia*); and finally getting beyond the limits of forest you reach a bare hill top.

On the eastern slope of the range, after passing through some precipitous ground sparely covered with deodar, holm oak, blue pine and juniper, you get on to easier slopes fairly covered with holm oak. High up on the hill side, and in unfrequented gorges, we find this tree growing well, and attaining a girth of 7 ft. and a height of 40-50 ft.; but lower down and near the road and villages it has been steadily pollarded, and forms a scrub about 12-15 ft. high. I have not succeeded in ascertaining the rate of growth of the holm oak; the annual rings are very indistinct, and I had no instrument for cutting microscopical sections.

It will probably be found that the only methods of working this particular holm oak forest are; either by regular cuttings in coppice, or by pollarding; probably the latter, as it would be most difficult to close any large part of it for any considerable period, so as to permit the coppice shoots to attain a height of say 7 ft., and so be safe from grazing. This part of the Peiwar forest can only be made useful in meeting the Shalozan fuel demand, and as it is very probable the forests to the north of Shalozan will suffice for this, the forest may be one of those left entirely for villagers.

The western slope of the Peiwar range has a fall of 1,300 ft. in ten miles, giving an average gradient of about 1 in 40; the ground is broken up by small gorges and ridges branching out from two main spurs running to Bian Kheyl and Ali Kheyl, the violent action of torrents of melted snow being very marked. Between Ali Kheyl and Mangiár are some extensive grassy plateaux generally bare of trees, and there is a similar plateau close to the Spingawai Pass; the area of the latter, known as the "Sonamurg," cannot be less than 400 acres.

Along the Peiwar range and for at least 2½ miles to the east the forest crop consists of deodar, spruce and silver fir, holm oak, blue pine and juniper; deodar I think forms 80 per cent. of the entire crop; in many places it is 95 per cent., but the general average is reduced by some gorges being filled with silver fir. Further west and down to Ali Kheyl, deodar, Gerard's pine, juniper and a few holm oak form the forest, deodar still standing at about 80 per cent. of the whole.

Throughout these forests the bare brown ground, and the almost entire absence of undergrowth, is a very marked feature, comparable to nothing I have seen in Himalayan forests. Cotoneaster willow, a viburnum, two roses, with some balsams and daphnes, are nearly all the shrubs and undergrowth found, and they have to be sought for.

I have been unable to make any exact examination of these deodar forests, save in the vicinity of the Peiwar Kotal; the results of my observations I append to this memorandum for reference.

The areas I examined are, I think, fair examples, as far as deodar goes, of about half the forest area between Peiwar Kotal, Mangiár and Ali Kheyl, and I think we may put the crop of deodar from 2 ft. girth and upwards at 50 trees per acre. Assuming the area at 16,000 acres, this would, deducting 8,000 acres for other classes of forest,

flanks and precipices, give 8,000 acres at 50 trees per acre, or 400,000 deodar trees. Of these about 17 per acre are 1st class trees, which gives a reserve of 136,000 trees, average height 100 ft., average girth 7 ft., probable yield in wrought timber 56 c.ft. per tree. The average age of a 6 ft. tree is 237 years, say 240, and it takes a 4 ft. 6-in. girth tree about 60 years to become of 1st class size. We might apparently, therefore, expect these forests to afford an annual yield of 2,200 trees, or, say, 23,200 c. ft. of wrought timber equal to 35,200 broad gauge sleepers.

These figures are of course but guesses; I believe, however, they convey a fairly accurate idea of the deodar resources of the Peiwar-Mangiár deodar forest.

Kuram Forests.

5. The Kuram forests form a belt along the southern face of the Safed Koh between Sika Rám and Karama peaks, varying in width from one to five miles, and in elevation from 7 to 11,000 ft.

The forest crop consists of holm oak at from 7,000 to 7,500 ft. Above this we find it mixed with spruce and silver fir and blue pine. At about 8,000 ft. the holm oak decreases, and its place is taken by the yellow oak, and this mixture is found to about 10,000 ft., where the crop is nearly pure silver fir and rhododendron. Deodar is only found in the Spingawai gorge to the extreme west, where a few moss-grown trees are scattered about in precipitous ground.

This forest is naturally divided by ridges into six large blocks, all of which can easily be worked for fuel by mule roads up the gorges, similar to one already made up the Shen Toi to the north-east of the Shalozan cantonment.

The lower parts of these forests are a good deal worked by the villagers for fuel, and as usual they lop branches instead of cutting up large wood. A little temporary cultivation had at times sprung up, but Shinwari raids have apparently tended to stop it.

There is a good deal more balsam and daphne to be seen in these gorges than on the Peiwar range, but the absence of undergrowth is still very marked.

The villagers appear to graze these gorges lightly, and I understand they also allow migratory tribes to graze here in the hot season when the valleys are unhealthy. On the lower slopes of the hills there is a little grass, which is burnt annually; the fire, however, does not appear to spread into the forest.

Forest requirements of the villagers.

6. In the course of describing the different forests, I have alluded to the villagers' forest requirements; they may be noted as—

(*a*).—Bullies and small timber for building, each village using the coniferous wood nearest to hand, and not being prejudiced in favour of deodar.

(*b*).—Fuel, which they take in the form of branches.

(*c*).—Leaves for fodder and ground for grazing.

As a rule, they have done wonderfully little damage to the forest in supplying their wants, and the fact has been noticed by many besides myself.

To provide for the wants of the actual inhabitants would in any other part of India be an easy task, and leave large areas of forests unburdened by rights. Here a settlement is complicated by the lawless nature of the people, and by the fact that an unknown number of outsiders have grazed and cut in these forests without let or hindrance.

In the opinion of the Political Officer at Kuram it will be most unadvisable for years to interfere in the exercise of forest rights beyond putting down the most objectionable practices through the headmen (Maliks) of villages, and clearly making the villagers understand that the forests are not theirs. It therefore is needless, I think, for me to dwell on the definition of forest rights and subsequent assignment of forest reserves.

Local requirements of Government.

We now come to the local requirements of Government from these forests. So little has been decided as to the method to be adopted for working the Kuram that these wants are very indefinite; I am led to believe however that for some years they will not exceed—

(*a*).—12,000 c. ft. of wrought deodár timber per annum.

(*b*).—120,000 mds. of fuel per annum.

These supplies are required partly at the Peiwar Kotal or its equivalent, at Ali Kheyl, at Shalozan or its equivalent, and at Kuram. Fortunately in one way, unfortunately in another, the demand can be easily met.

The extensive fellings made for military purposes near the Peiwar Kotal along the ridge towards Mangiár, and dry wood within a two-mile radius of the Peiwar Kotal, will, I am sure, yield at least a lakh of cubic feet of wrought timber; in fact, measurements made to act as a guide give 1½ lakhs as the quantity. We may safely say that the demand for timber is provided for for about eight years, or for four years, should it be doubled.

With regard to the fuel demand, the six gorges in the forests to the north of Shalozan (which I have called the Kuram forest) are simply filled with dry trees, the apparent accumulation of ages; they are so blocked up that in some cases the villagers use the ridges as lines of communication. In addition to the wood in the gorges which was carried thither by the snow, there is standing or fallen dry wood in the forest. At a very low estimate, I am sure dry fuel will yield nine lakhs of maunds, or, say, seven years' supply. The fuel demand figure is not, I believe, liable to increase.

The last point to be considered with regard to local demands is how the Government timber and fuel demand is to be met eight years hence. This question cannot be answered until it has been decided how the forest rights of villagers are to be met, and what areas can be preserved from grazing.

As far as the deodar timber goes, its equivalent, some 250 trees per annum, might be judiciously felled for a century without much damage; but I do not think this idea applies to the fuel demand, and most of the "Kuram Forest" must be closed before fellings equal to the demand can be made.

Export of timber to other districts.

7. It now remains for me to consider the question of exporting deodar from the Kuram to other districts. I have previously noted that the Hazár-Darakht river is not fit for floating timber, nor is the Hariáb (or Kariah as it is also called). Of the Kuram river I cannot speak from personal knowledge save from Thul to Kuram. This part of the river is good for floating scantlings in the flood season; and below Thul (in Wáziri territory) the river must be good to where it reaches Bannu and thence onwards to the Indus. The unknown water is from Kuram to Ali Kheyl. An obstruction is reported between Chapri and Kurkai, but as the natives have certainly floated

axed scantlings from Ali Kheyl to Bannu, there is little doubt that the river can be used for floating, and the question of down country communication, as far as water is concerned, may be taken as favourably settled.

The next point for consideration is the unsettled state of the country; this will apparently for some time preclude any extensive working in the forest, or on the river, as large working parties with escorts are not to be thought of. No forest work can possibly pay as long as workmen go in peril of their lives, for labor would under these circumstances be expensive and difficult to import.

The last and most important question is what closed forests we are to have, for until a given area has been closed at least one year, until fairly correct valuation surveys have been made of this closed area, and a plan of operation drawn up and approved; it will be destroying the forest to fell heavily, it will impoverish it to fell lightly, and the latter plan will, for obvious reasons, be financially a failure.

Granted security for life, closed forests, and ample authority for the Forest Department, I do not believe that timber from the most easily worked forest (Peiwar and Mangiár) can be exported at a profit. The long leads to the river, the difficulties in providing mechanical aids, the enormous rate of wages and the absence of competition, preclude for a long time the idea of cheap labor, so that for many years it is probable 10 ft. deodar sleepers could not be placed on the Indus at Kushyálgarh for less than Rs. 5 each.

Forest work in the Kuram Valley.

8. The last point requiring attention in this memorandum is the present work of the Forest Department in this Valley. Immediate heavy felling by departmental agency being inexpedient, the following is the only work left :—

(*a*).—The prevention of further destruction of the forest, save for strictly military reasons.

(*b*).—As soon as the Political Officers have decided to close any large forest area, and permit such area to be freely traversed, the examination in detail of the area with the view of ascertaining its value and the possibility of working it at a profit.

(*c*).—If, as may probably be the case, it be only possible for some time to carry out (*a*), the Forest Officer might supervise the small timber works for the supply of barrack timber.

The work sketched out requires no large or costly forest establishment: a junior Forest Officer, with one ranger, one forester and six guards, could easily carry it on. I would strongly advise his being placed under the orders of the Chief Engineer Officer, with directions to refer through him purely professional questions for the orders of the Inspector-General of Forests.

Saw-mills at Peiwar.

9. Reference has been made about the possibility of profitably erecting saw-mills in the Peiwar Kotal Forests. There is one stream with sufficient water for a small mill, but it would not pay owing to the cost of shifting logs to it. The only saw-mill that would pay is, I think, one or more circular saw benches worked by a portable engine; these would cut up planks, shingles, &c., for barracks, and could be moved to the logs.

Scarcity of grass in the Kuram Forests.

10. In closing this report, I would again invite attention to the marked absence of grass and undergrowth both within and outside the forest. From a forest point of view, this complicates the working of the forests by rendering the hill-side more liable to wash from melting snow. From a military point of view it is very serious as complicating the supply of forage.

(Signed) C. BAGSHAWE,

Depy. Conservator of Forests on special duty.

NOTE.—I would beg to record the great obligations I am under to Surgeons-Major Aitchison and Fleming for information afforded me regarding forests I was unable to visit personally, and through which they had botanised.

(Sd.) C. B.

Description of simple areas under forest examined at and near Peiwar Kotal.

I.

Area and locality.

Area two acres; forms part of the cemetery ravine below, and to the east of the "Block-house" picquet. Elevation about 8,600 feet.

Configuration, gradient and aspect.

The ground is undulating; average gradient 15°.

There is no cut water-course at the bottom of the ravine, but in some places there are hollows formed by the percolation of the snow water. The ravine is sheltered, and snow probably lies late. The aspect is south-east.

Rock and soil.

Rock lime-stone, soil clay-loam, with a deep layer of vegetable mould.

Stock.

In the sample area the crop is pure deodar, in other parts of the ravine a few holm oak are found, forming about 1-50th of the entire crop. There is very little undergrowth, a poisonous grass growing in tufts, and a few balsam and viburnum being all we find. In the vicinity reproduction of deodar is good in patches that have for some time been exposed to the light; the seedlings vary in age from two to about thirty years, and have mostly suffered from grazing during *the present year*. Fire has apparently never passed through the forest, but many trees have had patches of bark removed by the villagers.

Enumeration of deodar trees.

The enumeration and girth measurements made gave the following results :—

STANDING GREEN DEODAR.			DEODAR STUMPS.			TOTAL CROP DEODAR.			Remarks.
2 ft. to 4 ft. 6 in.	4 ft. 6 in. to 6 ft.	Above 6 ft.	2 ft. to 4 ft. 6 in.	4 ft. 6 in. to 6 ft.	Above 6 ft.	2 ft. to 4 ft. 6 in.	4 ft. 6 in. to 6 ft.	Above 6 ft.	
5	14	24	61	16	2	66	30	26	Stumps and trees measured about three feet from ground. Stumps all new ones.

There are few deodar below 2 feet girth in or near the area measured. An estimate of the height of the deodar here may be formed from the following measurements :—

1.	Girth 10 feet 9 inches ; height 115 feet.		
2.	„ 10 „ 3 „	„ 113 „	
3.	„ 9 „ 5 „	„ 106 „	Average 113 feet.
4.	„ 10 „ 6 „	„ 127 „	
5.	„ 12 „ 2 „	„ 103 „	

Rate of growth.

Trying to ascertain the rate of growth of deodar in these forests was very difficult, owing to the large number of rings per inch, and I had to adopt the plan of getting the tops of stumps cut off, and a selected plane or sloping line smoothed with a plane before I could, with any accuracy, count the annual rings : even then I was often in doubt, and the following must only be taken as approximately correct :—

Number.	Approximate girth in inches of stump about 3 ft. 1 in. from ground.	Radius counted in inches.	Rings counted on radius. 0 in. to 4 inches.	4 in. to 6 in	6 in. to 9 in.	9 in. to 12 in.	Above 12 in.	Total number of rings counted.	Average per inch per tree.	Average per inch for locality.	Remarks.
1	51	8	118	51	54*	...	...	223	27·87	25·46	* No. rings in 2 inches—1 inch, &c.—*Vide* radius. Larger stumps not available.
2	45	7	95	54	31*	...	...	180	25·71		
3	63	10	90	37	45	13*	...	185	18·50		
4	44	6 75	121	39	12	...	...	172	25·18		
5	45	7	141	35	17*	...	...	193	27·57		
6	42	6·25	97	87	9*	...	...	193	30·88		

The girths were taken over the bark ; the average thickness of deodar bark in the Peiwar forest being about ·66 of an inch. The *girths* are approximate only, as in some cases the stumps were chipped or broken. Twenty years have been allowed for the growth of a deodar to 3 feet from the ground, and that number has been added to the number of rings actually counted in the first four inches of radius. I arrived at this figure after counting the rings in a good many saplings, when I found unsuppressed and undamaged specimens took from 20 to 25 years to attain a height of 3 to 4 feet.

Summary

The previous observations may be summarised as follows :—
The deodar crop on a south-east slope was found to be—

(*a*).—60 trees of all classes per acre.

(*b*).—Average height of 1st class trees 113 ft.

(*c*).—Assuming the average growth per inch to be 25·46 annual rings, the average age of a 6 ft. tree appears to be 290 years.

The latter figure is founded on so few data that I only regard it as a guess, and as one that makes the average growth slower than it really is Slow growth in this ravine may be accounted for by the snow lying late and dryness at other seasons owing to the aspect.

General. The fellings in this and other places near the Kotal were made last winter for military reasons, and no further remark on the subject is necessary here or in other parts of this memo.

II.

Area and locality. Area two acres, which are near the Kotal, and to the south of the Kotal and Ali Kheyl road. Elevation about 8,500 ft.

Configuration, gradient and aspect. Unbroken slopes with no rock appearing on surface. Gradient 20°. Aspect east to north-east.

Rock and soil Lime-stone is found in the vicinity. Soil deep clay, with much vegetable mould.

Stock. In the sample area pure deodar, saving the presence of two or three holm oak and a juniper; in the vicinity there are about three spruce fir to be seen in as many acres of forest. There may be said to be no undergrowth, a few unhealthy viburnum and balsam being all we find; grass is entirely absent. There is no reproduction to be seen; this is probably due in part to the unfavorable aspect, in part to the main road of the country being so close at hand, which animals would graze along, and thus prevent the germination of seed. The forest has not suffered from fire, but some trees have been barked by villagers.

The valuation survey gave the following results :—

Enumeration of Deodar.

Green deodar.			Deodar stumps.			Total crop.			Remarks
2ft. to 4ft. 6 inches.	4ft. 6inches to 6ft.	Above 6ft.	2ft. to 4ft. 6 inches.	4ft. 6 inches to 6ft.	Above 6ft.	2ft. to 4ft. 6 inches.	4ft. 6 inches to 6ft.	Above 6ft.	
5	31	41	13	27	18	18	58	62	A few stumps are *old*.

The following heights were taken :—

1. Girth	12 feet	8 inches;	height	73 feet	80 feet average.
2. „	6 „	2 „	„	89 „	
3. „	9 „	1 „	„	82 „	
4. „	7 „	0 „	„	86 „	
5. „	8 „	7 „	„	70 „	

The growth of deodar in this aspect may be judged by the following :—

Number.	Approximate girth in inches at 3 ft.	Mean radius in inches.	Rings counted on radius. 0 inch to 4 inches.	4 inches to 6 inches.	6 inches to 9 inches.	9 inches to 12 inches.	Above 12 inches.	Total number of rings.	Average number per inch per tree.	Average number per locality per inch.	Remarks.
1	58	9·25	78	39	75	6*	...	198	21·40		See remarks and notes in memo. on area I.
2	87	14	58	38	68	44	25*	233	16·64		
3	57	9	88	56	76	...	...	220	24·44		*No. rings in 25 —2 inches, 1·50 inches, &c.—*vide* radius.
4	48	7·50	64	50	38*	...	...	152	20·26		
5	65	10	76	32	62	17*	...	187	18·70		
6	66	10·50	83	19	56	30*	...	218	20·76		
7	65	10·25	67	37	56	11*		171	16·68		
8	67	10·75	111	22	23	26*	...	182	16·93		
9	65	10	95	21	32	10*	...	158	15 80		
10	62	9·75	73	66	65	29*	...	233	23·89	20·30	
11	49	7·75	65	53	59*	...	...	177	22·83		
12	50	7·75	58	52	95*	...	...	205	26 45		
13	46	7·25	75	63	58*	...	...	196	27 03		
14	75	12·	14	20	66	61	...	191	16·16		
15	63	9 50	79	28	120	9*	...	236	24·84		
16	48	7·50	94	37	20*	...	...	151	20 13		
17	54	8·50	111	27	23*	...	...	161	18·94		
18	42	6·50	84	44	11*	...	...	139	21·38		
19	84	13 25	60	25	53	50	17*	205	15·47		
20	49	7 50	94	83	35*	...	...	212	28·26		

Although the variations in the observed growth are considerable, the number of annual rings in the first four inches of radius varying between 44 and 111, I think the figures are fairly reliable, and believe it will be found that a 1st class tree 6 ft. in girth takes about 231 years (probably more than less) to grow.

It will be noted that in this sample area there were 84 deodars 2 ft. girth and upwards per acre; the average height however was only 80 ft.

III.

Area and locality. Area two acres, situated on the right slope of the "Gordon Highlanders" gorge to the left of the Kotal and Ali Kheyl road.

Configuration, gradient and aspect. Unbroken slopes ; average gradient 25,° with occasional bits of level ground. Elevation about 8,700 ft. Aspect north-west.

Rock and soil. Metamorphic rock with traces of iron. Soil deep, sandy, with much vegetable mould on surface.

Stock. In the sample area pure deodar ; in the vicinity a few spruce and silver fir with some young blue pine are found.

Near the sample area is a clearing of about 3 chains square ; this is nearly covered with saplings of about 4 ft. high ; the growth consists of silver fir (9-10th), deodar (1-20th), spruce with a few blue pine (1-20th) ; beyond this clearing and in more shade are a few apparently *older* deodar and some sickly blue pine saplings. This clearing is surrounded on three sides by deodar, but nearly open on the ravine side (north-west.) ; it has two or three seed-bearing deodar in the middle, and at the bottom of the ravine, about 50 yards away, are three solitary silver firs. It is quite possible this displacement of deodar by silver fir is due to the seed of that tree falling soon after the clearing was made, and before any deodar seed fell. On the other hand, I have in many places noted a decided tendency on the part of the silver fir to encroach on deodar growing on northerly aspects.

There was little or no undergrowth in this area.

Enumeration of deodar.

Green deodar.			Deodar stumps.			Total crop.			Remarks.
2 ft. to 4 ft. 6 inches.	4 ft. 6 inches to 6 ft.	Above 6 ft.	2 ft. to 4 ft. 6 inches.	4 ft. 6 inches to 6 ft.	Above 6 ft.	2 ft. to 4 ft. 6 inches.	4 ft. 6 inches to 6 ft.	Above 6 ft.	
11	33	20	30	4	...	41	37	20	Partly old, partly new stumps—Few poles below 2 ft. girth.

The height of the deodar here may be judged from the following measurements made :—

1.	Girth 6 feet 9 inches ; height 76 feet...	Average height 77 feet.
2.	„ 8 „ 6 „ „ 70 „ ...	
3.	„ 7 „ 0 „ „ 71 „ ...	
4.	„ 6 „ 6 „ „ 79 „ ...	
5.	„ 7 „ 8 „ „ 84 „ ...	

The following number of stumps were examined to determine rate of growth; all the stumps were not in the sample area :—

Number.	Approximate girth of tree at 3 feet in inches.	Mean radius measured in inches.	Rings counted on radius. 0 inch to 4 inches.	4 inches to 6 inches.	6 inches to 9 inches	9 inches to 12 inches.	Above 12 inches.	Total number of rings	Average number per inch per tree.	Average number per inch per locality.	Remarks.
1	52	8	119	13	32	...		224	28·00	22 33	No. in 1 inch, ¼ inch, &c. —*vide* radius measurement.
2	90	14·50	84	39	69	61	39	295	20 34		
3	65	10	67	57	72	23	.	219	21 90		
4	56	8·75	76	47	71	..		191	22·17		
5	78	12 75	53	27	51	54	16	204	16 00		
6	50	7·75	97	91	29		.	220	28·38		
7	51	8	56	71	75	...	...	202	25·25		

In this part of the forest with a north-west aspect, we find 49 trees of all classes per acre, average height 77 ft.; age of a 6 ft tree about 254 years.

IV.

Area and locality.

Area two acres to right of Ali Kheyl and Kotal road, and beyond the Engineer's workshops.

Configuration, gradient and aspect.

The hill-side is a good deal cut up by small water-courses, and has occasional bits of level ground with some abrupt rocky slopes; gradient 27°, elevation 8,660 ft.; aspect southerly.

Rock and soil.

Lime-stone; soil poor, yellow clay with very little vegetable mould. The hill-side has suffered from the wash of the snow-water; some water springs are found near this sample area.

Stock

Deodar with a few holm oak and juniper. Undergrowth very little, consisting of viburnum, wild flax and thistles. Reproduction entirely absent. A few trees about here have been injured by fires lit at their bases, and by barking.

Enumeration survey.

Green deodar. 2 ft. to 4 ft. 6 inches.	4 ft. 6 inches to 6 ft.	Above 6 ft.	Deodar stumps. 2 ft. to 4 ft 6 inches	4 ft. 6 inches to 6 ft.	Above 6 ft.	Total crop. 2 ft. to 4 ft. 6 inches.	4 ft 6 inches to 6 ft	Above 6 ft.	Remarks.
2	6	21	21	11	16	23	17	37	Stumps partly old, partly new.

The following heights were noted :—

1.	Girth	11	feet	6	inches;	height	85	feet	Average height 79 feet.
2.	„	9	„	8	„	„	89	„ ...	
3.	„	9	„	10	„	„	79	„ ...	
4.	„	8	„	11	„	„	70	„ ...	
5.	„	11	„	1	„	„	73	„ ...	

Number.	Approximate girth of tree at 3 feet in inches.	Mean radius measured in inches.	Rings on mean radius. 0 Inch to 4 inches.	4 inches to 6 inches.	6 inches to 9 inches.	9 inches to 12 inches.	Above 12 inches.	Total number of rings.	Average number of rings per inch per tree.	Average number of rings per inch per locality.	Remarks.
1	78	12·50	81	21	25	25	7	159	12·72	14·52	Nos. on 1 inch. 75, 25 &c.—*vide* radius.
2	90	14·50	54	22	44	40	26	186	12·82		
3	84	13·50	69	36	15	14	...	134	9·92		
4	60	9·25	75	50	83	3	...	211	22·81		
5	71	11·25	65	33	55	43	...	196	17·42		

It will be seen from the preceding that the crop is only 39 trees per acre, and the average height but 79 ft. On the other hand, the growth is the most rapid yet found in these forests, a first class tree taking only 165 years to grow. The rapidity of growth may be attributed to the trees growing on a sheltered southern slope in the vicinity of water.

V.

Area and locality. About two and a half acres, lying above the hospital towards the Spingawai Pass.

Configuration, gradient and aspect. The ground is steep and rocky near the main ridge, with huge masses of lime-stone protruding through the soil. The side spur on which the sample area is, is rounded and even ; the area measured runs into the ravine or dip between it and the next side spur. Gradient 23° to 25°. Elevation about 8,750 ft. Aspect southerly.

Rock and soil. Lime-stone ; soil clay ; vegetable mould plentiful, save on ridge.

Stock. Deodar and holm oak, with a little undergrowth of wild roses and viburnum. All the deodar have been felled and most of the oak. A large part of the hill-side was burnt last summer when covered with leaves and branches, &c. ; in the unburnt portion a good many

deodar seedlings are visible; these are apparently two years' old; a few oak seedlings and coppice shoots are also found.

Deodar stumps.			Oak stumps.			Green oak.			Total crop, deodar and oak.		
2 ft. to 4 ft. 6 inches.	1 ft. 6 inches to 6 ft.	—	All Sizes.	—	—	All Sizes.	—	—	All Sizes.	—	—
36	46	63	127	...	...	49	...	...	321	...	...

This gives 58 deodar per acre, 128 deodar and oak per acre.

The following form gives the measurements of some of the deodar as found lying on ground after their tops and branches had been cut for fuel:—

Measurements of girth of trees.

Number.	Girth at butt end of tree about 4 ft. from ground.		Girth at 14 ft. from ground.		Girth at 24 ft. from ground.		Girth at 34 ft. from ground.		Girth at 44 ft. from ground.		Girth at 54 ft. from ground.		Girth at 64 ft from ground.		Girth at 74 ft. from ground.		Girth at 84 ft. from ground.		Girth at 94 ft. from ground.	
	ft.	in	ft.	in	ft.	in.	ft.	in.	ft.	in.	ft.	in.	ft.	in.	ft.	in.	ft.	in.	ft.	in.
1	9	...	8	6	7	6	6	..	4	6	..	...	..	...	..	..	...	...	...	...
2	6	...	5	6	5	2	4	10	3	7	...	...	.	..	...	..	...	...	...	...
3	8	9	7	4	6	9	5	3	3	9	..	..	..	..	...	...	...	...	...	...
4	6	3	5	9	6		5	...	4	3	...	...	...	..	...	..	...	...	...	...
5	8	9	8	..	7	6	7	..	6	6	...	...	...		..	...	...	...	...	...
6	8	7	7	3	6	4	6	..	5		4	3	...	..	...	...	...	...	...	...
7	12	..	9	7	9	6	8	6	8	..	..	..	...	..	..	..	..	...	...	...
8	9	...	7	...	6	3	5	9	5	3	4	2	3	3	2	9	..	...	...	...
9	4	..	4	.	4		4	.	3	3	3	.	2	8	1	8	..	...	...	...
10	7	9	7	3	6	6	5	3	5	..	4		...	..	..	...	...	...	...	...
11	6	3	5	2	4	3	3	7	3		2		...	...	...	..	...	...	..	...
12	7	...	6	10	6	2	5	7	4	6	4	3	..	...	...	..	..	...	...	...
13	9	...	7	4	6	6	5	11	5	...	4	3	3	...	...	...	..	...	...	...
14	11	..	9	9	9	..	8	...	7	..	6	6	5	6	4	6	3	9	...	...
15	5	..	4	9	5	...	4	9	4	6	4	...	3	..	...	...	...	...	...	...
16	6	8	6	...	5	6	5	...	3	6	3	..	..	...	..	...	...	...	...	...
17	11	..	12	...	10	6	9	9	8	9	8	...	7	2	6	...	5	3	...	...
18	7	8	8	..	8	...	7	8	7	6	7	...	6	9	...	..	...	...	...	...
19	7	9	7	3	7	3	5	..	4	8	3	9	...	...	...	..	...	..	...	...
20	10	..	9	3	8	9	8	6	8	3	7	3	6	6	6	...	...	...	..	...
21	8	..	8	...	7	3	6	11	6	6	6	...	5	9	4	6	..	...	...	...
22	8	2	8	...	7	6	6	9	5	10	5	3	4	11	...	...	...	...	...	...
23	8	8	8	..	8	4	6	9	6	..	5	6	...	...	...	..	...	...	...	...
24	10	..	8	3	7	...	6	3	5	3	5	...	3	9	2	9	..	...	..	...
25	7	.	7	..	6	6	6	6	6	3	5	...	4	4	3	6	...	...	...	...
26	6	8	5	6	4	9	4	..	3	3	2	3	...	...	...	...	...	...	...	...
27	8	9	8	9	7	9	7	3	6	..	5	...	4	..	2	9	...	...	...	...
28	7	..	6	3	5	9	4	9	4	6	...	...	...	...	..	...	...	...	...	...
29	9	..	8	6	8	4	6	9	5	1	..	...	...	...	...	...	...	...	...	...
30	6	3	5	9	5	9	5	...	4	3	4	...	...	...	...	...	...	...	...	...
31	6	3	5	8	5	.	4	8	4	8	4	...	...	...	...	...	..	...	...	...
32	8	9	6	...	5	..	4	9	3	6	2	6	..	...	..	...	...	...	...	...
33	8	...	7	3	6	3	5	6	4	3	2	3	...	...	..	...	..	...	...	...

This sample area was selected as one largely stocked with oaks, and as affording a good opportunity of measuring a number of trees; it was found, however, that the trees had been so much damaged in the collection of fuel that the measurements of only one-fourth were worth recording.

Rate of growth.

Number.	Approximate girth at about 3 ft. from ground in inches.	Mean radius counted in inches.	Rings counted on radius. 0 in. to 4 in.	4 in. to 6 in	6 in. to 9 in.	9 in. to 12 in.	Above 12 in.	Total number of rings.	Average number of rings per inch per tree.	Average number of rings per inch per locality.	Remarks.
1	84	13·50	64	17	77	118	60	336	24·88	21·61	No. rings ·75, 1·00, 2·00, 2·25, &c.—*vide* radius.
2	73	11·50	118	63	86	43	...	310	26·95		
3	81	13·	95	67	63	52	17	294	22·61		
4	78	12·50	117	54	79	43	8	301	24·08		
5	81	13.	118	42	66	34	9	269	20·69		
6	92	15·	74	31	41	67	121	334	22·26		
7	71	11·	67	21	45	35	...	168	15 27		
8	121	19·75	56	41	32	34	186	349	17·67		

It will be noted that while the aspect of this plot is southerly, the growth is much slower than in the godown plot (No. 4); this may be accounted for by the dry nature of the spur, rock being near the surface, &c., but also tends to shew that growth near the godown is abnormally quick. The age of a 1st class tree (6 ft. girth) appears to be 246 years in the hospital plot, or slower in growth than an average tree in these forests.

(Signed) C. BAGSHAWE,

Deputy Conservator of Forests.

Exd. G. C. M.

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